Using virtual reality to model and predict occupant behaviour: wayfinding and navigation

Conference or Workshop Item

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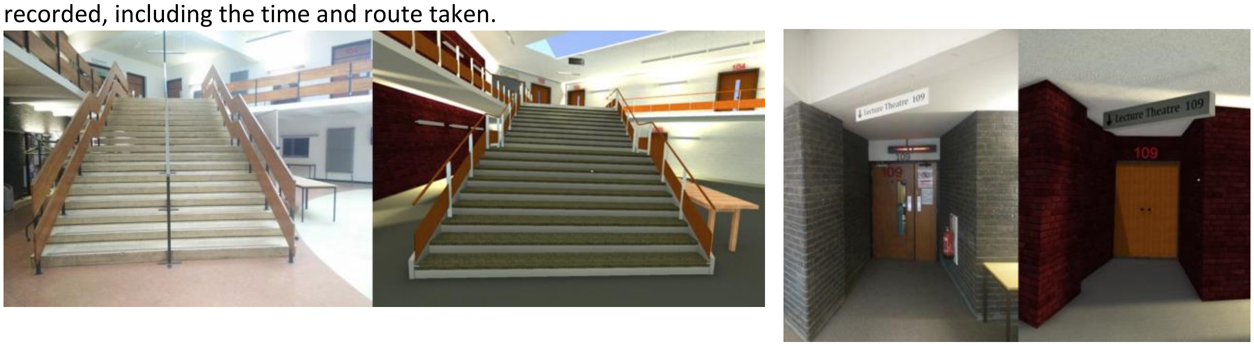
Using Virtual Reality to model and predict occupant behaviour: Wayfinding and navigation.

Background and Identification of Problem / Knowledge Gap:
It is widely reported that Virtual Reality (VR) holds potential in the architecture, engineering and construction sectors (AEC) for providing the experience of a building at various stages prior to completion (Whyte and Nikolić, 2018). Most commonly this includes the design phase, especially as a tool for collaboration, and during construction, especially as a tool to increase efficiency and identify potential mistakes. There is an implicit assumption in accepting these ideas that the representation produced and experienced in the Virtual Environment is in some way analogous to the environment that will be experienced in the real world. Furthermore, especially in its use in the design phase and with the recognition of the importance of participatory design and stakeholder involvement, VR is seen as a tool for testing and predicting occupant behaviours. However, it is not clear to what extent the Virtual experience is representative of the Real experience (Kilteni et al. 2012), and how we should embrace and accommodate those differences. There is an acknowledged “lack of appropriation validation studies” that is leading to the rapid uptake of VR for potentially unsuitable purposes (Nilsson and Kinateder, 2015:13). Hence the work reported here, although it focusses on a single facet of the building experience, namely wayfinding, has wider implications for the use of VR in AEC, and more specifically the use of VR data as the basis for design decisions.

Research Aim and Methodology
This project sought to answer the question: Can a Virtual Reality Environment assist in wayfinding and navigation around an unfamiliar real building?
To do this we produced a reasonably realistic model of part of a building (see Figure 1), running in an Oculus Rift VR head mounted display, and set up in the entrance area of the same real building. Volunteers were asked to complete a wayfinding task, to navigate from the entrance to a specific room, and to make the journey in both the VRE and the real building. The target room (Room 109) was chosen on the basis that it provided a simple choice of directions, with distinct signage cues, and restricted lines of sight along the route (See Figure 2).
Participants reach Room 109 by going from the entrance, up the stairs, and then either turning left (the shorter route) or right (the longer route, suggested by following the room numbers from 102 directly in front, 103 to its right, then 104 etc.) Participants were divided into two groups – Group 1 carried out the task in the VRE first, then the real building; Group 2 carried out the task in the real building first, then the VRE. A total of 60 journeys were recorded, including the time and route taken.



Figures 1a, 1b: Examples of Real Environment (RE) left, and Virtual Environment (VRE) right.

Research Findings
Figures 3a-d summarise the results, and show that both Groups made similar changes in their route selection, with a far greater proportion choosing the shorter route second time around, whether this was in the VRE or real building, and a consequent reduction in time taken. Taken at face value, this suggests that a Virtual Environment can act as a realistic model to predict the behaviour of occupants in wayfinding and becoming familiar with the layout of a building. However, we also noted subtle but important differences in the way the two environments were experienced, including greater risk taking in the VRE (e.g. jumps), and more head movement in the real

environment. Therefore, we need to adopt a cautious approach when designing by VR, and recognise that the results of behaviour tests in a VRE should complement design decisions, rather than act as their sole justification.

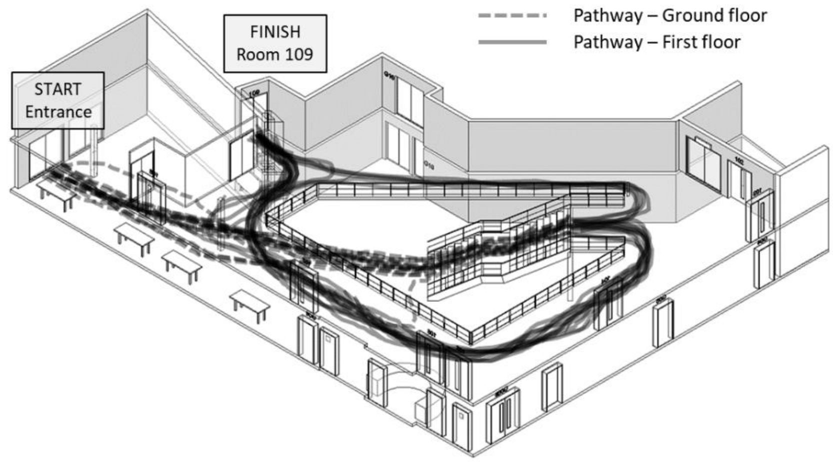
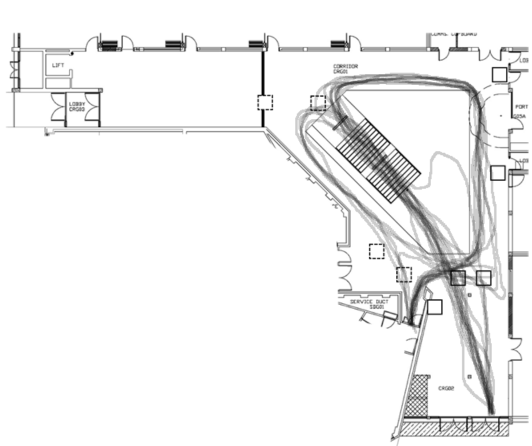
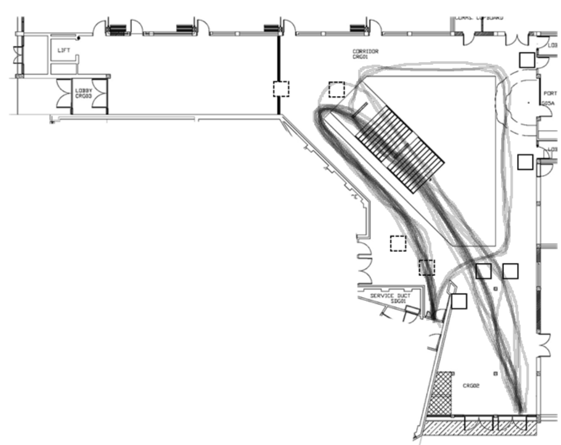


Figure 2: Isometric view of the Case Study part of the building, showing Wayfinding Task 'Start Point' and 'End Point' showing individual wayfinding paths. Note the choice of two primary routes: turning left or right at the top of the stairs.

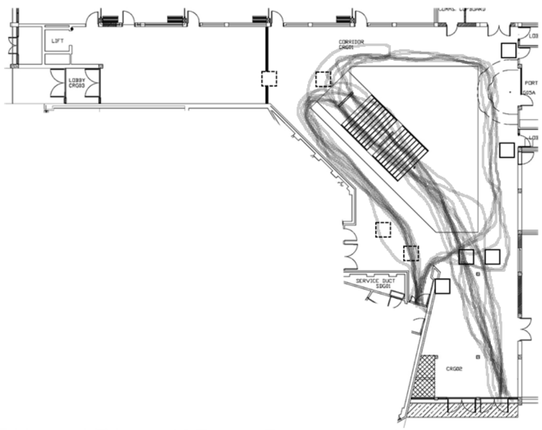
Group 1 (VR first; RE second):

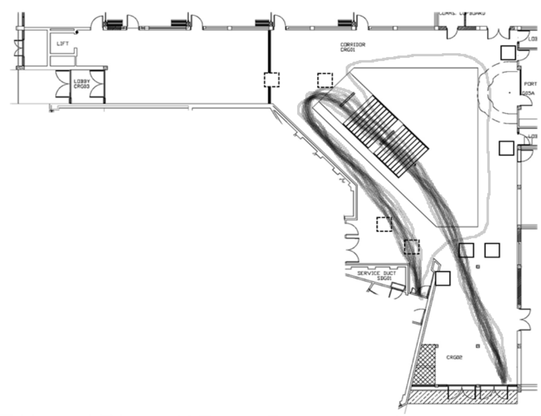




4a: First attempt in VR (43.9 secs.) *4b: Second attempt in RE (39.9 secs.)*

Group 2 (RE first; VR second):





4c: First attempt in RE (46.6 secs.) *4d: Second attempt in VR (35.0 secs.)*

References

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